Chapter One

The clear starry skies of the Middle East always fascinated those dwelling beneath them. For millennia, nomadic Bedouin traversed the bleak sandy wastes with neither compass nor map. Specific fixed stars in the firmament aided them and their camels – the 'ships of the desert' – to navigate through the ocean of dunes.

Egyptians, Sumerians and Babylonians all cultivated the study of the heavens (astronomy) and, from very early times, the complex mapping of the stars. Much later, even more complex star charts and tables (known as *zij* in Persian and Arabic) and navigational instruments like the astrolabe helped the traveller on land and sea.

Signs of Allah

With the arrival of Islam in the 7th century and the revelation of *Kitab Allah*, the Noble Qur'an, to all humanity, Muslims became fully aware of their place in the universe. Throughout the Qur'an, man is encouraged to ponder the Signs of Allah.

يَٰٓأَيُّهَا ٱلنَّاسُ ٱعْبُدُوا۟ رَبَّكُمُ ٱلَّذِى خَلَقَكُمْ وَٱلَّذِينَ مِن قَبْلِكُمْ لَعَلَّكُمْ تَتَّقُونَ ﴿٢١﴾ ٱلَّذِى جَعَلَ لَكُمُ ٱلْأَرْضَ فِرَٰشًا وَٱلسَّمَآءَ بِنَآءً
وَأَنزَلَ مِنَ ٱلسَّمَآءِ مَآءً فَأَخْرَجَ بِهِۦ مِنَ ٱلثَّمَرَٰتِ رِزْقًا لَّكُمْ ۖ فَلَا تَجْعَلُوا۟ لِلَّهِ أَندَادًا وَأَنتُمْ تَعْلَمُونَ ﴿٢٢﴾ البقرة: ٢١ – ٢٢

(O mankind! Worship your Lord [Allah], Who created you and those who were before you so that you may acquire *taqwa* [piety]. Who has made the earth a resting place for you, and the sky as a canopy, and sent down water [rain] from the sky and brought forth therewith fruits as a provision for you. Then do not set up rivals unto Allah [in worship] while you know [that He alone has the right to be worshipped].) *Surah Al-Baqarah*: 21-22

Birth of Islamic Science

Islamic science was able to flourish because of its wholly Qur'anic origins. Both the Qur'an and the Prophet Muhammad ﷺ admonished believers to seek knowledge. Early Muslim scholars, all with a deep-rooted faith in *Din al-Haq*, would go on to make amazing discoveries. Greek science was preserved for all time when Muslims decided to translate the canon of ancient texts into Arabic. Once this knowledge had been absorbed by Muslims, Islamic science advanced by leaps and bounds. Over several centuries, Allah-fearing scientists from Al-Andalus (Muslim Spain) to Central Asia produced works of astonishing originality in literally every branch of knowledge[4].

[4] The number of known Muslim polymaths (persons of encyclopedic learning) who lived during the 9th to the 13th centuries is truly remarkable. Nasir al-Din al-Tusi (1201-1274), for example, was not only a prolific writer, but also an astronomer, biologist, chemist, logician, mathematician, philosopher, physician, physicist, scientist, and theologian. Other noteworthy polymaths include Al-Biruni, Ibn Khaldun and Ibn Sina.

Muslim View of the Universe

How did Muslims view their world? What beliefs about the physical nature of the Earth were disproved in the Qur'an? Just how scientifically advanced were Muslims once they had correctly interpreted Allah's many *ayat* ('Signs')?

Three *ayat* in particular aided Muslims in constructing their heliocentric[5] view of the universe.

وَٱلشَّمْسُ تَجْرِى لِمُسْتَقَرٍّ لَّهَا ۚ ذَٰلِكَ تَقْدِيرُ ٱلْعَزِيزِ ٱلْعَلِيمِ ﴿٣٨﴾ وَٱلْقَمَرَ قَدَّرْنَٰهُ مَنَازِلَ حَتَّىٰ عَادَ كَٱلْعُرْجُونِ ٱلْقَدِيمِ ﴿٣٩﴾ لَا
ٱلشَّمْسُ يَنۢبَغِى لَهَآ أَن تُدْرِكَ ٱلْقَمَرَ وَلَا ٱلَّيْلُ سَابِقُ ٱلنَّهَارِ ۚ وَكُلٌّ فِى فَلَكٍ يَسْبَحُونَ ﴿٤٠﴾ يس: ٣٨ – ٤٠

(And the sun runs on its fixed course for a term [appointed]. That is the Decree of the All-Mighty, the All-Knowing. And the moon. We have measured for its mansions [to traverse] till it returns like the old dried curved date stalk. It is not for the sun to overtake the moon, nor does the night outstrip the day. They all float [swim], each in an orbit [sphere].) *Surah Ya Sin*: 38-40

Here, Allah mentions the sun and moon each "swimming in a sphere". The Arabic verb يسبحون [*yasbihūn*] implies 'floating' or 'swimming' and, therefore, the sun's independent movement in the universe. Also the sun does not "overtake the moon," thus indicating that the two heavenly bodies do not orbit around the Earth.

In another *ayah*, Allah, *al-Khalaq*, clearly identifies the movement of the Earth as what causes the sun to shine in the daytime and to be absent at night.

وَٱلشَّمْسِ وَضُحَىٰهَا ﴿١﴾ وَٱلْقَمَرِ إِذَا تَلَىٰهَا ﴿٢﴾ وَٱلنَّهَارِ إِذَا جَلَّىٰهَا ﴿٣﴾ وَٱلَّيْلِ إِذَا يَغْشَىٰهَا ﴿٤﴾ الشمس: ١ – ٤

(By the sun and its brightness. By the moon as it follows it [the sun]. By the day as it shows up [the sun's] brightness. By the night as it conceals it [the sun].) *Surah Al-Shams*: 1-4

Finally, in the following *ayah*, Allah states that "He wraps the night up in the day…". In this verse, the Arabic verb يُكَوِّرُ [*yukawwiru*] conveys the meaning of 'wrapping one thing around another', as in wrapping a turban around a head. From this one word alone, we can know the true shape of the Earth.

[5] The 'heliocentric' view refers to the belief that the Sun, not the Earth, was the centre of the universe. The Ptolemaic (Greek) hypothesis – believed for more than a thousand years – was known as the 'geocentric' view, which placed the Earth at the centre of the universe.

خَلَقَ ٱلسَّمَٰوَٰتِ وَٱلۡأَرۡضَ بِٱلۡحَقِّۖ يُكَوِّرُ ٱلَّيۡلَ عَلَى ٱلنَّهَارِ وَيُكَوِّرُ ٱلنَّهَارَ عَلَى ٱلَّيۡلِۖ وَسَخَّرَ ٱلشَّمۡسَ وَٱلۡقَمَرَۖ كُلٌّ

يَجۡرِي لِأَجَلٖ مُّسَمًّىۗ أَلَا هُوَ ٱلۡعَزِيزُ ٱلۡغَفَّٰرُ ۝٥ الزمر: ٥

(He has created the Heavens and the Earth with truth. He wraps the night up in the day, and wraps the day up in the night. And He has subjected the sun and the moon. Each running [on a fixed course] for an appointed term. Verily, He is the All-Mighty, the Oft-Forgiving.) *Surah Al-Zumar*: 5

European View of the Universe

In the classical world[6], it was presumed that the Earth was the centre of the universe. The Greeks perpetuated this myth with the philosopher, Aristotle and the geographer, Claudius Ptolemy, both endorsing it. They assumed the sun, moon, stars and all observable planets circled the Earth. This 'geocentric' view of the universe was accepted in Europe well into the middle of the 16th century – and beyond in some areas.

Two European astronomers, Nicholas Copernicus (1473-1543) and Galilei Galileo (1564-1642) are given credit for first formulating a heliocentric view of the heavens. One question, however, is increasingly being asked today: Could Copernicus have made this discovery without the aid of Islamic science? While Muslims had believed for centuries that the Sun, not the Earth, was the centre of our universe, Copernicus[7] is given full credit for proving the heliocentric thesis.

Nasir al-Din al-Tusi

Even many Western scholars today tend to agree that Copernicus must have made use of Islamic sources in advancing his mathematical theory. The Persian polymath, Nasir al-Din al-Tusi (1201-1274), is often cited as being his most logical source. For twelve years, Al-Tusi used the state-of-the-art Ilkhanid observatory (built by Hulagu Khan) in Maragha (northwest Iran) to make accurate tables of planetary movements. These were later compiled in his book, the *Zij-i Ilkhani* ('Ilkhanid Tables'). Using his tables and some advanced computing techniques, Al-Tusi developed a very sophisticated and new planetary model of the universe.

It has been suggested that Copernicus could have discovered Al-Tusi's ground-breaking astronomical work when he was a student in Italy. The fact remains that the basics of Copernican theory can be found in Al-Tusi's writing. While it is clear to all that Copernicus was influenced by Muslim scholarship, the exact route of transmission remains unclear.

[6] The classical world here refers to the world of Greece and Rome. Interestingly, the Hindus of India and the Mayans of Central America did not accept a geocentric view of the universe, but believed in a heliocentric one.

[7] In 1610, Galileo scientifically proved this theory by using a telescope.

With the arrival of Islam in the 7th century and the revelation of *Kitab Allah* (i.e., the Noble Qur'an) to all humanity, Muslims became fully aware of their place in the universe.

Chapter Four

Ptolemy was a Roman citizen of Greek and Egyptian ancestry. The Latin-speaking Roman emperors of his day did not seem to encourage their scholars to continue the great tradition of Greek cartography.

The East Roman Empire, namely Greek-speaking Byzantium (324-1453), was centred in the eastern Mediterranean. Here the classical Greek language was still taught and for centuries the Byzantine Empire proudly preserved many traditions of the ancient Greek world. Vast manuscript libraries filled the cosmopolitan capital of Constantinople (Istanbul).

Byzantine Maps

Very few Byzantine maps exist because of several historical events. Constantinople was devastated in 1204 when it was ruthlessly sacked by the Latin armies of the Fourth Crusade[19]. These Catholic crusaders of God laid waste to Orthodox Christian Byzantium and in the ensuing bloodbath, much of the literary heritage (including the cartographic production) of this thousand-year-old empire was lost forever.

What survived of the Byzantine cartographic record, however, is truly amazing. While perishable parchment and paper maps are extremely rare, several Byzantine mosaic 'floor maps' do exist. Although very unconventional, these mosaic maps made from hundreds of thousands of tiny glazed *tesserae*[20] are simply an extension of a Byzantine art form perfected over many centuries.

The inside walls of Saint Sophia[21] were covered in golden *tesserae*. Byzantine mosaicists were so renowned that they were invited to embellish the interiors of some of the first monuments in Islam: the Umayyad Mosque in Damascus, the *Qubbat al-Sakhra'* ('Dome of the Rock'), and the Al-Aqsa Mosque, both in Jerusalem. The same colourful mosaic tiles were even sent to beautify the *mihrab*[22] of the Great Mosque of Cordoba, Spain in the 10th century.

The most interesting example of Byzantine monumental cartography is the 'floor map' which depicts western Asia, Palestine and the eastern Mediterranean lands. This mosaic map is located in the apse of

[19] The Fourth Crusade (1202-1204) was launched by Pope Innocent III in 1202 with the intention of retaking Jerusalem by first invading Egypt. Instead of proceeding to the Holy Land, the Catholic crusaders vented their anger against co-religionists, the Greek Orthodox Byzantines. In three days of wanton destruction, the grand, imperial capital of Byzantium was left in utter ruins, never to fully recover. The magnificent Library of Constantinople, the last of the great libraries of the ancient world which had preserved classical learning for a thousand years, was destroyed in the chaos.

[20] *Tesserae* are simply small glass, ceramic tile or stone squares or cubes which are used to assemble mosaic patterns. Some of the *tesserae* sent as a gift from the Byzantine emperor to the Spanish Umayyad caliph in the 10th century were reportedly glass cubes with embedded sheets of pure gold.

[21] *Haghia Sophia*, or the 'Church of the Holy Wisdom', was the main church of Byzantium for more than a thousand years, until the Turkish seizure in 1453; since 1935, it has been a museum.

[22] See the author's work *The Most Beautiful Mihrab*. Riyadh: Darussalam Publishers, 2008.

While Byzantine paper maps are extremely rare, several mosaic 'floor maps' exist. These mosaic maps are made from hundreds of thousands of tiny glazed *tesserae* (tiles). The Byzantine 'floor map' at Madaba, Jordan depicts western Asia, Palestine and the eastern Mediterranean lands.

Chapter Seven

The Islamic world of the 10th century comprised a vast area of the inhabited world, stretching from Al-Andalus (modern Spain and Portugal) and the *Maghreb* regions of North Africa in the west, to the foothills of the high Tien Shan Mountains of Central Asia in the east. For all Muslims living in these areas, the spiritual capital of the world was, of course, the Blessed City of Makkah, while Baghdad of the 'Abbasids was their centre of culture. What united the mosaic of ethnic groups across large swathes of Africa and Asia was faith in *Din Al-Haq al-Islam*.

Adab al-Rihlah

By the 10th century, established centres of high civilization such as Cordoba, Fez, Qayrawan, Cairo, Damascus and Baghdad were producing outstanding scholars in all branches of science. An 'information explosion' resulted from the availability of inexpensive paper and the vast number of books being written by these scholars. By this time, a type of 'travel literature' – *adab al-rihlah* – had developed in Arabic. The authors of these geographical works were seasoned travellers themselves. One very important writer of such books was Muhammad Abu Qasim ibn Hawqal (died ca. 990).

Ibn Hawqal

Most details about Ibn Hawqal's life are gleaned from his detailed writings. He was born in the ancient city of Nasibin, modern Nusaybin, in southeastern Turkey. He appears to have begun travelling while still a very young man and possibly supported himself by being a merchant.

Ibn Hawqal first visited North Africa as far as the southern limits of the Sahara Desert. He went north into Al-Andalus (Spain) and from there passed through southern Italy and Egypt on his way home to Iraq. He then proceeded north into Armenia and Azerbaijan in the Caucasus Mountains and later went south into Iran and parts of Central Asia. One can only imagine the difficulties of travelling such long distances during those times.

Kitab Surat al-'Ardh

Ibn Hawqal was a very keen observer and recorded and/or remembered an amazing amount of detail about the various regions he passed through. Eventually, upon returning home to Iraq, he became a geographer associated with the Balkhi School of mapmakers in Baghdad. It was here that he began writing his main geographical work: a book entitled *Kitab Surat al-'Ardh* ('Book of the Depiction of the World'), which was completed in 977. In older travel books, writers had provided notes to accompany the maps, but little or no description of the countries visited was offered. Ibn Hawqal, however, made his book one that specialized in maps of Islamic lands that he had visited. Wonderfully detailed maps covering most regions of *Dar al-Islam* were included in the *Kitab Surat al-'Ardh*. But what really distinguished this book from all the others being written were the extensive informative commentaries supplied alongside the maps.

Besides being a remarkable geographer, Ibn Hawqal was also a very accomplished cartographer. His *Kitab Surat al-'Ardh* contains many fine regional maps, as well as his famous world map.

Chapter Fourteen

For centuries, Muslims had been fueling Europe's cultural renaissance. Important works of Greek science, lost to Europe, were rediscovered in the 9th century and preserved in Arabic translation for future generations. This knowledge[73] – along with so many original Arabic works in all branches of science from astronomy to ophthalmology and pharmacology – reached Europe via translation centres in Islamic Sicily and Al-Andalus.

As we have seen, Muslims also shared their cartographic knowledge with the West. However, their contributions to the science of mapmaking ended in the 16th century, when European powers in their quest for overseas colonies initiated the world-wide voyages of discovery. This 'Age of Discovery' resulted in the mapping of most of the remaining regions of the Earth. Perhaps the last in line of the great Muslim scholars to convey Islamic learning to Europe was the Moroccan-born traveler and mapmaker, Al-Hasan ibn Muhammad al-Wazzan al-Fasi, better known in the West as Leo Africanus.

Al-Hasan al-Wazzan

Al-Hasan al-Wazzan was born in Granada in 1494. For two centuries, this part of Spain had been the last Muslim stronghold in all of the Iberian Peninsula. Finally, in 1492, the *reconquista*[74] was completed when Abu 'Abd Allah, the last Muslim monarch of Al-Andalus, ceded power to the Christian king and queen of Spain. The Muslim inhabitants of Spain were initially permitted to continue practicing their Islamic faith, but by the end of the century, the Spanish authorities reneged on these promises. Muslims were being forcibly converted to Catholicism. Outwardly, they appeared to be 'new' Christians, but inwardly, they still professed an unwavering belief in لا إله إلا الله محمد رسول الله. These Muslims now living under Christian domination were known as *Moriscos*[75].

Al-Hasan al-Wazzan's family, along with thousands of other Spanish Muslims, could not tolerate living under such oppressive conditions. They fled from Spain and sought shelter in safer corners of *Dar al-Islam*. Some chose to emigrate to Morocco, and in particular, to its intellectual capital of Fez. Al-Hasan al-Wazzan's family and many other wealthy *Morisco* émigré families settled in the Andalusian quarter of the city. Al-Hasan al-Wazzan received and excellent education at the prestigious Qarawiyyin Mosque (university), where he became a *faqih* (legal scholar) at the age of fourteen!

[73] Examples of such important Greek works include the *Almagest*, Ptolemy's enormously important book on mathematical astronomy. It was translated for the first time into Latin (from Arabic) by Gerard of Cremona (1114-1187), the greatest of all Toledan translators. He specifically learned Arabic in Al-Andalus in order to complete this translation. Ibn Rushd's commentaries on Aristotle and Ibn Sina's medical text, *Al-Qanun fi al-Tibb*, translated into Latin and other languages, provided ample teaching material for the fledgling universities of Western Europe.

[74] The *reconquista* was the centuries-long struggle by Spanish Christians to retake the Iberian Peninsula from Muslim control.

[75] See the author's book, *The Well-Travelled Qur'an*. Riyadh: Darussalam Publishers, 2009.

In the 16th century, the desert town of Timbuktu (in today's West African state of Mali) was an important centre for Islamic studies with resident scholars maintained by the sultan. Al-Hasan al-Wazzan (Leo Africanus) visited the region and was very impressed by the thriving book markets, where manuscripts were sold for more than any other merchandise.

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The Persian polymath, Nasir al-Din al-Tusi (1201-1274), worked at the state-of-the-art observatory built by Hulagu Khan at Maraghah (northwestern Iran). His book of astronomical tables (the *Zij-i Ilkhani*, the 'Ilkhanid Tables') was used to calculate the position of the planets. This illustration depicts a geometric technique, which he invented, called the 'Tusi-couple'. This technique was later employed by Nicholas Copernicus in his heliocentric model of the universe.

Glossary

***Adab al-Rihlah*:** Arabic for 'travel literature'; travelogues written by Muslims

Anaximander: an ancient Greek scientist; honoured as being the first cartographer

Balkhi School: an academy for mapmakers in Baghdad; geographers and mapmakers from this school produced unique maps which eliminated all unnecessary detail

***Bayt al-Hikmah*:** Arabic for 'House of Wisdom'; the translation academy founded in Baghdad by the 'Abbasid caliphs Harun al-Rashid and Al-Ma'mun in the 9th century CE

Al-Biruni: a Persian-speaking polymath who made important contributions to a dozen branches of science

Canary Islands: 'the Fortunate Isles'; the group of Atlantic islands off the coast of Morocco; Ptolemy placed his prime meridian of longitude at this location

Cartography: the art and science of mapmaking

***Convivencia*:** Spanish term for the peaceful coexistence between Jews, Christians and Muslims in 10th century Al-Andalus

Copernicus, Nicholas: a Polish polymath who formulated a comprehensive heliocentric view of the universe

***Diwan Lughat al-Turk*:** Mahmud al-Kashghari's dictionary of Turkish languages

Eratosthenes: an ancient Greek mathematician; first to accurately calculate the circumference of the Earth and the tilt of the its axis

Galileo, Galilei: an Italian physicist, mathematician and astronomer; his improvements to the telescope enabled him to support Copernicus' heliocentric view of the universe; called 'the father of observational astronomy'

Geocentric View: the belief that the Earth was the centre of the universe and that the sun, moon and stars all circled the Earth

***Geographia*:** an important book written in Greek by Ptolemy of Alexandria; a guide to mapmaking which influenced mapmakers for more than 1,000 years

Ghaznavids: a Turkish dynasty founded in Afghanistan; Ghaznavid sultan Mahmud brought Islam to many parts of northern India

Google Earth: a well-known web-based geographic information programme

Roger II: the king of the unified Norman Kingdom of Sicily; employed Al-Idrisi to draft his world map

Seljuqs: Turks, originally from Central Asia, who founded two Islamic dynasties

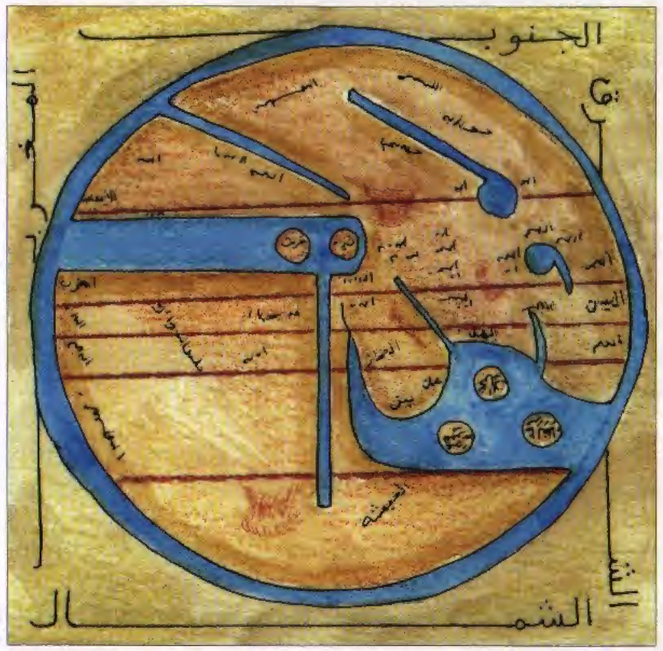
***Surat al-'Ardh*:** Arabic for 'the depiction of the Earth'; the name given to Arab and Persian world maps; unique feature of these maps is that the south is placed at the top

Talas, Battle of: the decisive battle in 751 between the 'Abbasid Muslim and Chinese Tang armies; captive Chinese papermakers taught Muslims the secrets of papermaking

Timbuktu: a once important centre of Islamic learning in present-day Mali (West Africa); it was famous for its extensive book markets

Al-Tusi, Nasir al-Din: the Persian polymath whose planetary model of the universe might have influenced Copernicus and his heliocentric view of the universe

***Zij*:** the Persian term used to identify complex astronomical tables of stars and planetary movements



Al-Balkhi (850-934) was a Persian polymath who founded the Balkhi School of mapmakers in Baghdad. The most famous members of this school were Istakhri and Ibn Hawqal, who focused on mapping and describing *Dar al-Islam*. This world map depicts climatic boundaries (Arabic *iqlim*, from Greek *klimata*).

Comprehension Questions

Now, you can test your knowledge of this story by answering the following questions.

Chapter One

1. What have nomadic Bedouin done for millennia?
2. What do Bedouin call their camels?
3. What three Middle Eastern civilizations studied the heavens?
4. What is the Persian and Arabic term for complex star charts and tables?
5. When did man become fully aware of his place in the universe?
6. What does the Noble Qur'an encourage man to do?
7. What enabled Islamic science to flourish?
8. How was Greek science preserved for all time?
9. What enabled Islamic science to advance?
10. Who produced works of astonishing originality?
11. What is the heliocentric view of the universe?
12. What three *ayat* aided Muslims in constructing their heliocentric view of the universe?
13. What meaning does the Arabic verb يُكَوِّرُ [*yukawwiru*] convey and what is its significance?
14. What myth did the Greeks perpetuate?
15. What is the geocentric view of the universe and for how long was it accepted?
16. Who are usually given credit for formulating the heliocentric view of the universe?
17. What question is increasingly being asked today?
18. What do many Western scholars today tend to agree on?
19. Who is a polymath?
20. Whose work might have helped Copernicus in developing his mathematical theory?
21. Who was Al-Tusi and what helped him make accurate tables of planetary movements?
22. What famous book did Al-Tusi write?
23. What did Al-Tusi develop? How did he achieve this?
24. What can be found in Al-Tusi's writing?
25. What did Galileo do in 1610?

Chapter Two

1. When did all branches of Islamic science develop?
2. What campaign was started in the early 9th century?
3. What texts were studied and rewritten?
4. What was the new universal language?
5. What was preserved for posterity?
6. What did all of this translated material create?
7. What did this 'information explosion' permit Muslims to do?
8. What one book had an enormous effect on Muslim scientists?
9. What did Ptolemy explain in his book?
10. Why is it not surprising that scientists in Baghdad became interested in mapmaking?
11. What made the Egyptians expert mathematicians?
12. Did the Egyptians produce world maps?
13. On what material were Mesopotamian maps inscribed?
14. What is considered by some to be the oldest world map?
15. Why is this map 'egocentric'?
16. How is this Babylonian map similar to the Greek Ptolemaic maps?
17. What do triangles and small circles indicate on this map?
18. What do the vertical lines represent?
19. What countries are mentioned by name on the Babylonian world map?
20. What was the purpose of the Babylonian map?

Chapter Three

1. What forced the ancient Greeks to become seafaring people?
2. What were the Greeks interested in knowing?
3. What had the ancient Greeks done by the 6th century BCE?
4. Where is Miletus and why is it important?
5. What did Greek minds produce?
6. Who is called 'the first cartographer'?
7. What does his world map show?
8. What happened as the geographical knowledge of the Greeks increased?
9. Which philosopher first suggested the Earth was a sphere?
10. What three things did Aristotle observe?
11. What did Eratosthenes measure?
12. What made this a major achievement?
13. Who was Eratosthenes and what did he want to produce?
14. What did his technique use?

15. What did he correctly divide the Earth into?
16. What did he also suggest?
17. Once the shape of the Earth had been accurately established, what important question arose?
18. Who was Claudius Ptolemy?
19. What book did he write and why is it important?
20. Who did this book help?
21. What did Ptolemy believe?
22. What did he further develop?
23. What did Ptolemy divide the spherical Earth into?
24. What did Ptolemy use for his 0° prime meridian?
25. Until where did his lines of longitude reach?
26. What did Ptolemy plot on his map?
27. What did Ptolemy's *Geographia* include?
28. What was Ptolemy's most serious error?
29. What did this result in?
30. Why did Columbus underestimate the distance to India travelling west from Europe?
31. What do historians often wonder about?
32. What was another weakness in Ptolemy's world map?
33 How are India and Sri Lanka shown on this map?
34. When and where was the original Greek text of the *Geographia* first translated?
35. When did Europe first hear of Ptolemy?
36. Where was the *Geographia* first translated into Latin?
37. What universal custom originated with Ptolemy?
38. What did Ptolemy's *Geographia* include?

Chapter Four

1. Who was Ptolemy?
2. Who were not interested in cartography as much as the Greeks?
3. Where was the East Roman Empire and where was it centred?
4. What did the Byzantine Empire preserve?
5. What happened to Constantinople in 1204?
6. What was lost forever?
7. Although Byzantine paper maps are rare, what has survived from the Byzantine cartographic record?
8. What are the mosaic maps made from?
9. What covered the inside walls of Saint Sophia?